Center Innovation Fund: JPL CIF

High Temperature Superconductor Resonator Detectors

Completed Technology Project (2011 - 2013)

Project Introduction

High Temperature Superconductor (HTS) infrared detectors were studied for years but never matured sufficiently for infusion into instruments. Several recent developments support a renewal of effort: (1) Microresonator technology represents a new approach to array readout that can enable large-scale HTS bolometer arrays for Earth-observing and planetary missions. (2) Space-borne passive cooling and single-stage refrigerators are now commonplace, enabling cost effective cooling to 40-80 K.

There is a well-established need for more sensitive detectors in the 10 - 200 um wavelength range with high detectivity, D*>1010 cm-Hz1/2/W to increase the mapping speed for Earth and planetary science applications. LTS direct detectors with background limited performance are being widely deployed in arrays, in both space and ground-based situations (up to 104 pixels in the latter case). Megapixel array Si Blocked Impurity Band (BIB) and HgCdTe detectors are also widely used, but have a very sharp cutoff in sensitivity for >30 um. In addition, Si BIBs and LTS detectors require multi-stage refrigeration to 1000 at temperatures up to 75 K. The shift in resonance frequency under infrared irradiation, due to increasing temperature, enables each device to function as a thermometer for a separate bolometer pixel. Our current effort is directed towards achieving similar results with membrane-isolated devices by placing HTS resonators on SiNx membranes on Si substrates. Single transition edge sensor bolometers on SiNx membranes were demonstrated at JPL in 1995. We are employing an improved micromachining approach to membrane fabrication that is currently used to fabricate large arrays of resonator-based sensors based on low temperature superconductors. Our near-term goals are: (1) Development of a suitable fabrication process, including buffer layer and superconductor deposition, microresonator and readout circuit patterning, passivation, and membrane micromachining. (2) DC and microwave device characterization versus temperature and frequency. Follow-on work will concentrate on optical characterization of working detector arrays and extension to 2D arrays.

Anticipated Benefits

None.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

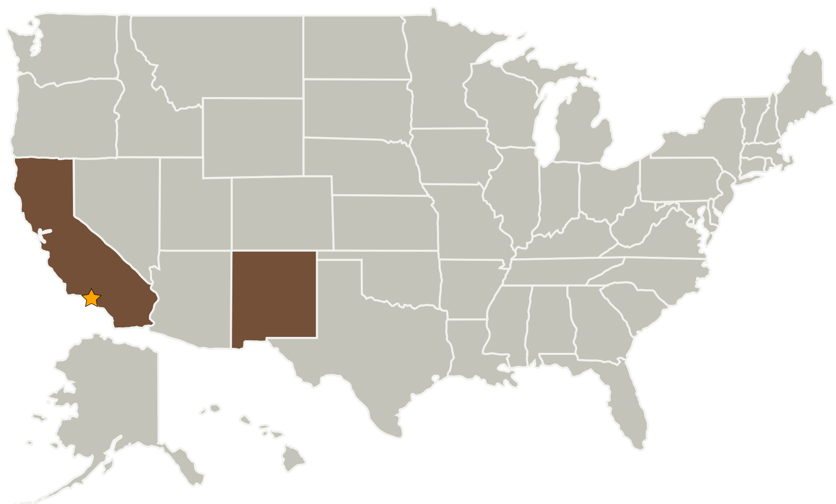
Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Innovation Fund: JPL CIF

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	New Mexico

Project Management

Program Director:
Michael R Lapointe

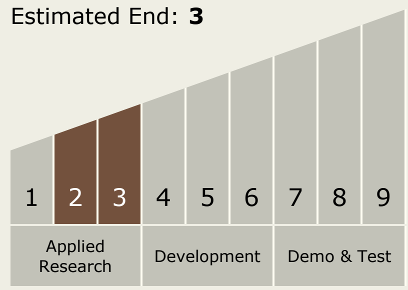
Program Manager:
Fred Y Hadaegh

Project Manager:
Jonas Zmuidzinas

Principal Investigator:
Alan W Kleinsasser

Technology Maturity (TRL)

Start: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  └─ TX08.1 Remote Sensing Instruments/Sensors
    └─ TX08.1.1 Detectors and Focal Planes